Sessions 1 and 2

Halves of Rectangles and Solids

Materials

- Color tiles (1 tub per 6–8 students)
- Prepared sets of Geoblocks (1 per group)
- Student Sheet 7 (1 per student, optional)
- Student Sheet 16 (about 4 per student, class; 2 per student, homework)
- Student Sheet 21 (1 per student)
- Student Sheet 22 (1 per student, homework)
- Crayons or markers to match the colors of the tiles
- Chart paper

What Happens

Students use two colors of tiles to make rectangular arrays that are half one color and half another. They use two colors to color the same rectangle in two ways—to show halves and not halves. They find Geoblocks that are one-half of another Geoblock. Choice Time is used as a Teacher Checkpoint. Their work focuses on:

- constructing two-dimensional arrays that are divided into halves
- constructing arrays to represent numbers and identifying halves of the arrays
- representing rectangles using two colors to show halves and not halves
- investigating halves with three-dimensional solids

Start-Up

Today's Number Sometime during the school day, students express Today's Number using doubles in their number sentences. For example, if the number they are working on is 98, possible combinations include: 49 + 49, or 45 + 45 + 4 + 4. Add a card to the class counting strip and fill in the next number on the blank 200 chart. For complete details on this routine, see p. 116.

Activity

Half-and-Half Rectangles

Distribute color tiles and Student Sheet 16, Inch Graph Paper, to students. Students also need crayons or markers to match the colors of the tiles.

In the last few math sessions you have made many different rectangles. Today we're going to make rectangles that follow a special rule—they will be half one color and half another color.

Make a rectangle with 6 tiles. Make one-half of the rectangle [red] and one-half of it [green]. When you have made your rectangle, draw it on your graph paper and color it to match the tiles.

Observe students as they work. Do they automatically take 3 tiles of each color? Do they seem to make their rectangles somewhat randomly, one tile at a time? What shape rectangle do students make—a 2-by-3 or a 1-by-6? Are they unable to keep track of both aspects of the task? Do they forget to think about the total number of tiles or that half must be each color?

After students have made and recorded their rectangles, call the class together.

Everyone has made a rectangle using 6 tiles that is half one color and half another color. Do you think all the rectangles look the same?

Students can show their drawings to the class. After each student shows his or her rectangle, ask questions such as the following.

- **Does this rectangle use six tiles? Is one-half of the rectangle [red] and one-half [green]?**
- **Who has a rectangle like this one? Who has a different rectangle?**

Expect students to disagree about whether a rectangle has been divided into halves. See the **Teacher Note**, Halves of Rectangles (p. 80), and the **Dialogue Box,** What Is a Half? (p. 81), for examples of diverse thinking on what constitutes a half.

Unequal Parts If you have not yet talked about a rectangle where the two parts are *not* equal, make a rectangle such as this one.

Is this rectangle one-half [red] and one-half [green]? Why or why not?

Next, ask students to try making a rectangle that is half one color and half another color using 7 tiles.

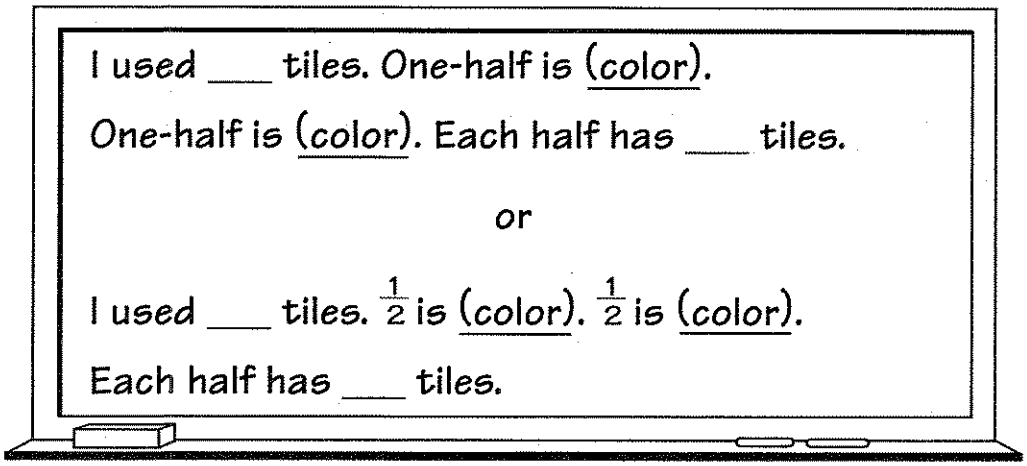
Notice how students approach this task. Do some students know, even without trying, that it's impossible? Do other students start manipulating and arranging tiles?

After several minutes, stop students and ask them what they found. If all students agree that it's an impossible task, accept their statement. If some students make a rectangle with 3 tiles of one color and 4 of the other and say that it's about half and half, tell them that for this problem, the number of each color tile must be exactly the same. If some students believe that it really is possible but that they just haven't found out how to do it yet, don't try to convince them otherwise. These students will need more time manipulating the tiles to convince themselves.

Getting Ready for Choice Time Tell students that during Choice Time they will work with a partner and investigate which numbers they can use to make half-and-half rectangles. Students can work with the numbers they used previously, 8 to 36, using color tiles to build rectangles for the numbers.

If you find a way to make a rectangle half one color and half another color, copy the rectangle on the student sheet and color it. If you find more than one way to make a half-and-half rectangle, show that way on the student sheet also. For each rectangle you draw, write a sentence under your drawing and fill in the blanks.

Write one of the following sentences on the board and read it with the class:



You may want to check to see whether students know how to write the notation ½. Although the meaning of the numerator and the denominator is not emphasized in this unit, you might point out that the 2 in the number means that a whole is divided into two equal parts.

Label a sheet of chart paper "Impossible Half-and-Half Tile Rectangles." Post the chart and explain that if students find it impossible to make a half-and-half rectangle for a number, they are to write the number on the chart.

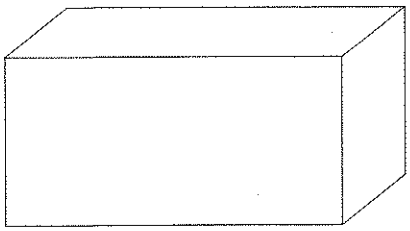
Activity

Introducing Halves of Geoblocks

Gather students in a circle around a set of Geoblocks. Students should be able to see all the blocks in the set. Hold up the square prism that measures 8 cm by 4 cm by 4 cm.

Is there a Geoblock that is one-half of this block?

Let a few students try to find such a block, or hold a 4-cm cube and ask:



Is this block (cube) one-half of this block (prism)? How could you prove it? Could there be a different block that also is half of this block?

Have a student show that two cubes can be put together to make the prism.

Note: There are three Geoblocks that are half of the 8-cm-by-4-cm-by-4-cm rectangular prism: a 4-cm cube; a rectangular prism, 8 cm by 4 cm by 2 cm; and a wedge, 8 cm by 4 cm by 4 cm.

Students will continue this activity during Choice Time. Tell them that they will look for blocks that are one-half of another block—two identical blocks that when put together will form another Geoblock. When they find blocks that are half of other blocks, they should keep the blocks together until you come over to see what they have done. No more than about six students should share each set of Geoblocks.

Activity

Teacher Checkpoint

Choice Time

Post the following list on the chalkboard:

1. Half-and-Half Rectangles
2. Halves of Geoblocks
3. Halves and Not Halves

Students will work on these activities for the remainder of Sessions 1 and 2. Make sure students understand Choice Time activities 1 and 2. As they finish one of these activities, introduce some students to Choice 3. You may want to assign and keep track of which students do the Geoblock activity, since no more than about six students should share one (half) set of blocks.

Choice 1: Half-and-Half Rectangles

Materials: Color tiles; Student Sheet 16, Inch Graph Paper; crayons or markers to match the tiles

Students choose a number from 8 to 36 and use two colors of tiles to see whether they can make a rectangle that is half one color and half another. They copy each half-and-half rectangle they find for the number on Student Sheet 16, Inch Graph Paper. After drawing and coloring each rectangle, students write a statement below it to describe the rectangle. See Teacher Note, Halves of Rectangles (p. 80), for examples of what you may see.

If students find a number for which it is impossible to make a half-and-half rectangle, they write the number on a chart labeled "Impossible Half-and-Half Tile Rectangles."

When students have finished making half-and-half rectangles for one number, they choose a different number to investigate, recording each rectangle on graph paper. Some pairs may prefer to find many different half-and-half arrangements for a particular number. Others may prefer to find only one arrangement before investigating a different number.

Choice 2: Halves of Geoblocks

Materials: Geoblocks; Student Sheet 7, Build the Geoblock (optional)

Students find blocks that are one-half of another block. They prove this by putting two identical blocks together and placing them by the Geoblock that is twice as large.

You may need to help students get started on this choice. If you wish more structure for this activity, you can have students use Student Sheet 7, Build the Geoblock (used in Investigation 1). For each block pictured, students look for blocks that are one-half of that block. Alternatively, set out a specific block and ask students to find each block that is half of it. (For many of the blocks, there are several possibilities.)

Choice 3: Halves and Not Halves

Materials: Student Sheet 21, Halves and Not Halves; crayons in two colors; color tiles

Students use crayons in two colors to color a pair of rectangles that have the same dimensions so one shows halves and the other does not. They may use color tiles to help them plan how to color the rectangles.

Activity

Teacher Checkpoint

Halves

Observing the Students

Use this Choice Time as a Teacher Checkpoint to gain information about what students understand about halves. As you observe students working on each activity, use these questions to guide your observations.

- Do students make sense of halves in the different tasks?
- Do students understand that halves are always two parts and the parts are always equal?

Halves of Geoblocks

Consider these questions as you observe students working with Geoblocks.

- Have students found more than one block that is half of another block? Do students recognize that all the half blocks are the same size? You may want to ask, "Do all three of these blocks (that are half of this block) contain the same amount of wood, or does one block have more wood than the others?" This may be a difficult question for many students, so don't expect students to come to agreement about this.

Halves and Not Halves

Consider these questions as students color to show halves and not halves.

- Is this activity easy for students? Do they have to think a lot about how to color the rectangles appropriately?
- Can students justify why they know they have colored in the rectangles in halves or not-halves? If students are having difficulty, ask questions such as, "If I colored 2 squares red and 4 squares green, would it be half red and half green? Why or why not?" Some students may color in the rectangles all the same (or in a similar) way, for example, coloring the left half red and the right half blue. Other students may vary the ways they color in the rectangles, trying to make each rectangle different.

Sessions 1 and 2 Follow-Up

Homework

Half-and-Half Rectangles After Session 1, students take home copies of Student Sheet 16, Inch Graph Paper, to find more half-and-half rectangles for a number they are investigating or a number that was not investigated during the class session. Students should find at least one rectangle that *can* be divided in half. You may want to have students write "halves" and the number they are investigating at the top of Student Sheet 16 before they take it home.

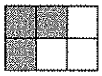
Things That Come in Halves After Session 2, students look for examples of things around the house that are in halves. They either bring those examples to school or draw pictures of them on Student Sheet 22, Things That Come in Halves.

Teacher Note — Halves of Rectangles

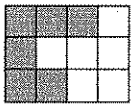
As students work on Half-and-Half Rectangles, you are likely to see several different kinds of responses.

- Some students will make rectangular halves. They may think that only these shapes are "halves."

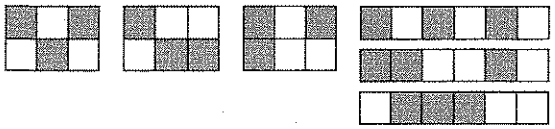
- Some students will make congruent, non-rectangular halves.



- When working with a number of tiles such as 12, some students may make noncongruent halves.



- Some students will make more than two pieces, explaining that there are the same number of [red] tiles as [green] tiles.

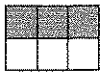


What to accept as the meaning of ½ depends on the context in which the term is being used. To divide a whole into halves, we usually assume that we are dividing something into two equal-size pieces. When we talk about half of a set of objects, we mean that there will be two groups with the same number of objects in each group.

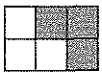
In Sessions 1 and 2, as students work on the activities Half-and-Half Rectangles and Halves and Not Halves, they are dividing both a rectangular array of tiles and a whole (a rectangular region) into halves. Some students will view the problem as dividing a whole into halves, and some will view the problem as partitioning a set of squares into halves. These sessions should help students integrate these two views.

For students who do not accept noncongruent halves or halves consisting of unconnected parts, you might rearrange tiles to see what they will accept.

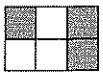
Is this rectangle half [red] and half [green]? How do you know? How many [red] tiles are there? How many [green]?



How about now? Is this rectangle half [red] and half [green]? How do you know? How many [red] tiles are there? How many [green]?



How about now? Is this rectangle half [red] and half [green]? How do you know? How many [red] tiles are there? How many [green]?



Note that even though you might discuss using the number of squares to judge halves, some students may not be able to accept this criterion. For them, the halves must be visually the same, or the halves must be capable of being physically separated (as if two people were sharing a candy bar). In the latter case, you might discuss how some candy bars are separated into squares and ask if the only way to share is to break it down the middle. You might ask, "What if I gave you three separate squares and me three separate squares (from a candy bar with six squares)? Would we each have one-half of the candy bar?"

DIALOGUE BOX

What Is a Half?

In this discussion during the activity, Half-and-Half Rectangles (p. 74), students discuss different arrangements for rectangles that are half one color and half another.

Angel: My rectangle has 1 red row and 1 green row. I put 3 tiles in each row.

So each row is a half, and the rows are the same size. Let's look at a different rectangle. Let's look at that long skinny one. Is it a half-and-half rectangle?

Tim: Yes.

How can you tell?

Tim: It has 3 red tiles and then 3 green tiles.

Karina: Mine's just one row, but half of the row is red, and half of the row is green.

Look at Paul's rectangle. How is Paul's rectangle like Angel's?

Paul: It has two rows.

Laura: It has 6 tiles, and it's a rectangle.

Is it the same shape?

Students: Yes.

Is it half and half?

Phoebe: No, you can't make it like that.

Laura: Yes you can.

Paul: It's half and half, but it's in a pattern.

Look carefully at Paul's rectangle and at Angel's rectangle. How many red tiles does each rectangle have? How many green tiles ?

Paul: 3 reds and 3 greens.

Phoebe: They each have 3 red tiles and 3 green tiles.

How are their rectangles different?

Jess: The tiles are checkered in Paul's and in rows in Angel's.

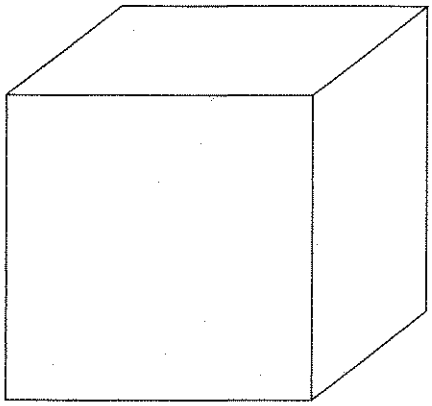
Paul's half and Angel's half have different shapes, but each half has the same number of tiles. Phoebe, if you and Paul shared his rectangle, with you taking the red tiles and Paul the green, would each of you have one-half?

Name Date

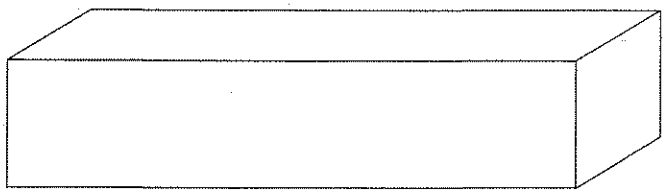
Student Sheet 7

Build the Geoblock

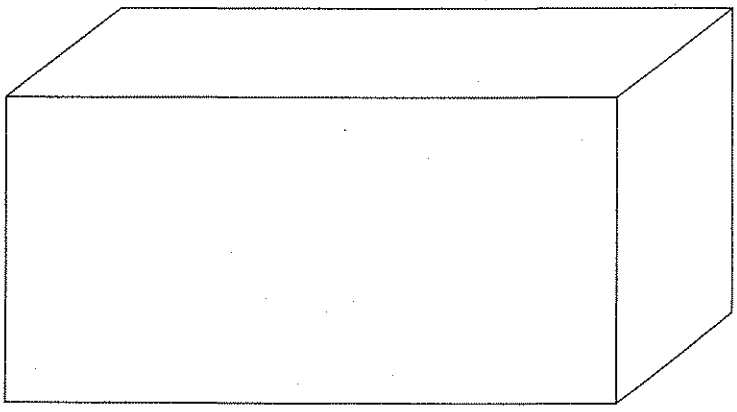
1. Put Geoblocks together to build this block.



2. Put Geoblocks together to build this block.



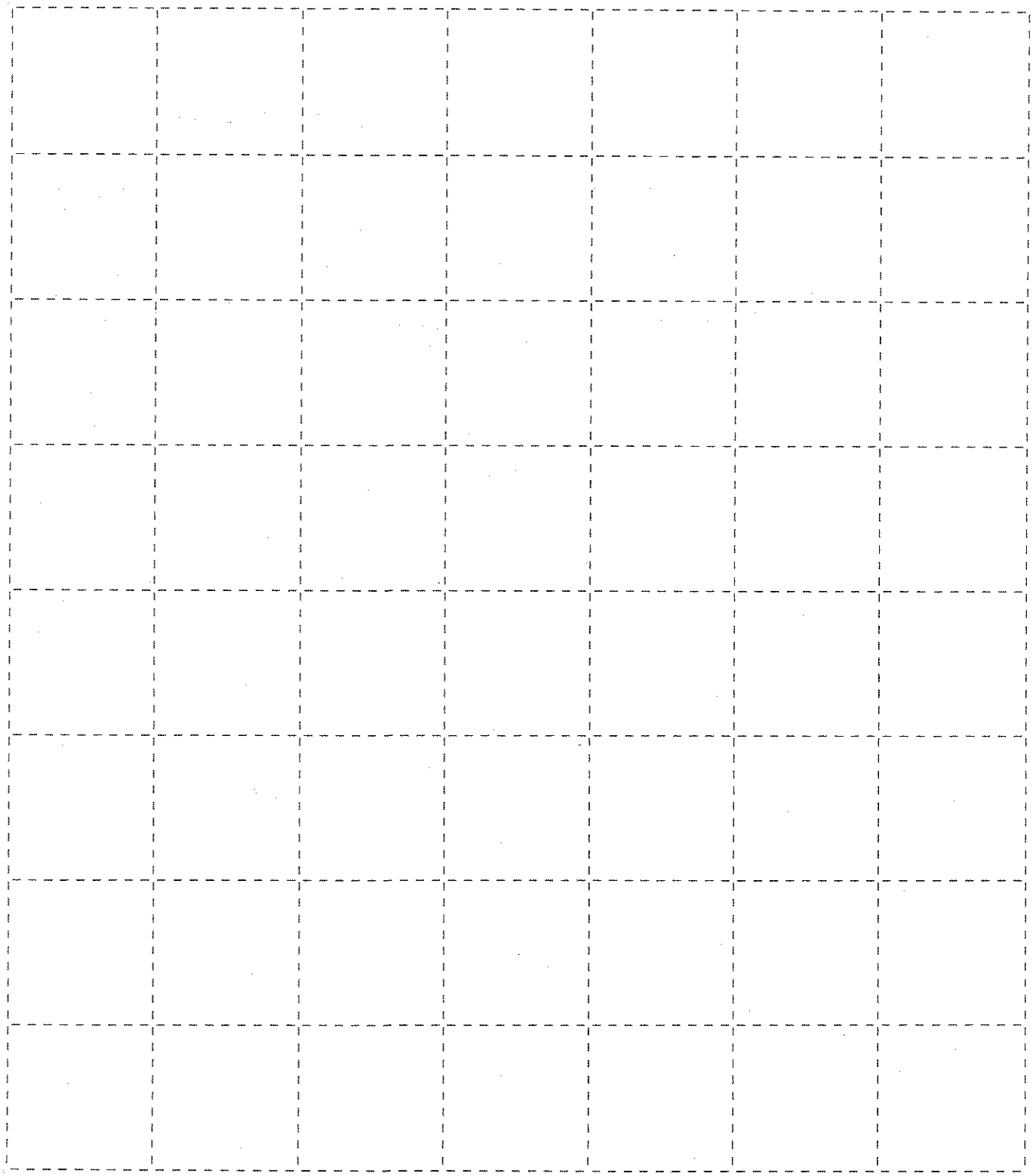
3. Put Geoblocks together to build this block.



Name Date

Student Sheet 16

Inch Graph Paper



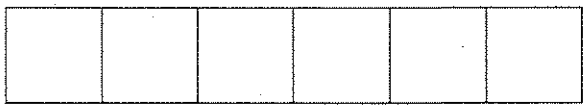
Name Date

Student Sheet 21

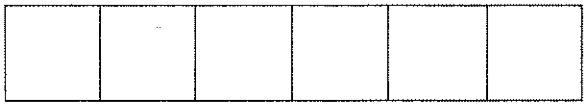
Halves and Not Halves

Use 2 colors. Color each rectangle to show halves and not halves.

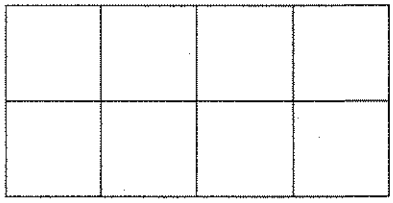
1. Half-and-Half



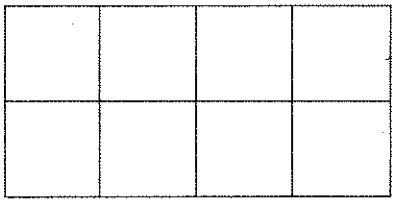
Not Half-and-Half



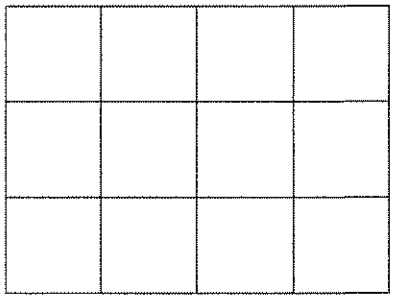
2. Half-and-Half



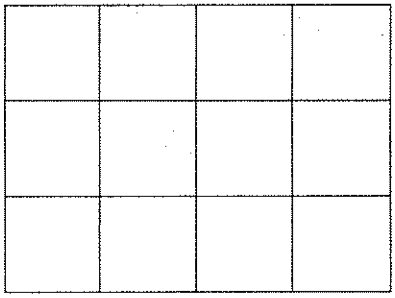
Not Half-and-Half



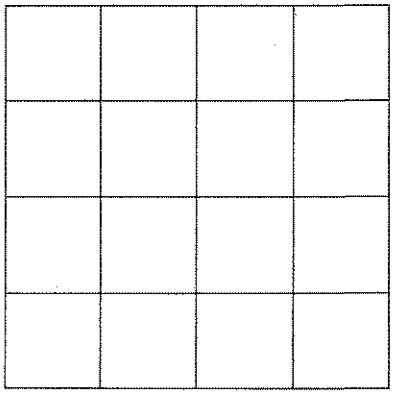
3. Half-and-Half



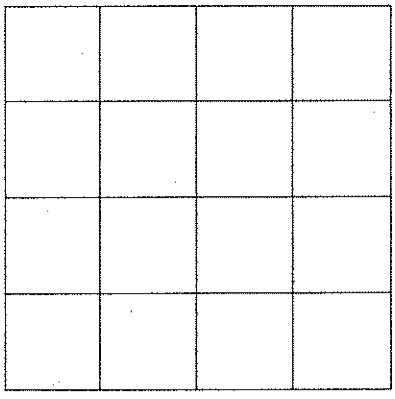
Not Half-and-Half



4. Half-and-Half



Not Half-and-Half



Name Date

Student Sheet 22

Things That Come in Halves

Find things around your home that come in halves. Draw a picture of any items you find. Bring one or two things to school if you can.